PRACTICAL 3

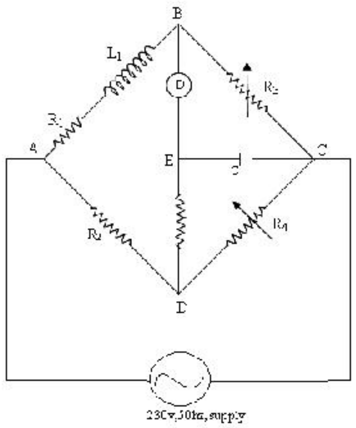
AIM: - TEST THE INDUCTANCE BY USING UNIVERSAL IMPEDANCE BRIDGE

OBJECTIVE: - To find the unknown inductance of a coil or inductor using Anderson's bridge. As a universal impedance bridge.

❖ APPARATUS:-

Sl. NO.	NAME	TYPE	RANGE	QTY.
1	Anderson's bridge circuit			1 no
2.	Head phones			1 no.
3.	Decade inductance box			1 no.
4.	DMM	DIGITAL		1 no.
5.	Patch cards			1set
6	RPS		230	1 no
7	Galvanometer			1 no

❖ CIRCUIT DIAGRAM:



❖ THEORY :

Anderson's bridge is a modification of the Maxwell's inductance capacitance bridge. In this method, the self-inductance is measured in terms of a standard capacitor. This method is applicable for precise measurement of self-inductance over a very wide range of values.

Figure shows the connections and the phasor diagram of the bridge for balanced conditions:

Let L_1 = Self-inductance to be measure

R_1 = resistance of self-inductor,

r_1 = resistance connected in series with self-inductor,

r, R_2, R_3, R_4 = known non-inductive resistances, and

C = fixed standard capacitor.

At balance, $I_1 = I_3$ and $I_2 = I_c + I_4$

Now $I_1R_3 = L_c \times \frac{1}{j\mu C}$ $\therefore$ $I_c = I_1 j\omega CR_3$.

Writing the other balance equations

$I_1 (r_1+R_1+j\omega L_1) = I_2 R_2 + I_c r$ and $I_c\left(r + \frac{1}{j\mu C}\right) = (I_2 - I_c) R_4$.

Substituting the value of I_c in the above equations, we have

$I_1(r_1+R_1+j\omega L_1) = I_2R_2+I_1 j\omega C R_3 r$

Or

$I_1(r+R_1+j\omega L_1-j\omega CR_3 r) = I_2R_2$ …(i)

and

$j\omega CR_3 I_1\left(r + \frac{1}{j\mu C}\right) = (I_2 - Ij\omega CR_3)R_4$ or $I_1(j\omega CR_3 r + j\omega CR_3R_4 + R_3) = I_2R_4$… (ii)

From Eqns. (i) and (ii), we obtain

$$I_1 (r_1 + R_1 + j\omega l_1 - j\omega CR_3 r) = I_1 \left(\frac{R_2 R_3}{R_4} + \frac{j\mu CR_2 R_3 r}{R_4} + j\mu CR_3 R_2 \right)$$

Equating the real and the imaginary parts : $R_1 = \frac{R_2 R_3}{R_4} - r_1$

and $L_1 = C \frac{R_3}{R_4} [r(R_4 + R_2) + R_2 R_4]$

An examination of balance equations reveals that to obtain easy convergence of balance, alternate adjustments of r_1 and should be done as they appear in only one of the two balance equations.

❖ ADVANTAGES:

1. In case adjustments are carried out by manipulating control over r_1 and r, they become independent of each other. This is a marked superiority over sliding balance conditions met with low Q coils when measuring axwell's bridge. A study of convergence conditions would reveal that it is much easier to obtain balance in the case of Anderson's bridge than in Maxwell's bridge for low Q-coils.

2. A fixed capacitor can be used instead of a variable capacitor as in the case of Maxwell's bridge.

3. This bridge may be used for accurate determination of capacitance in terms of inductance.

❖ DISADVANTAGES:

1. The Anderson's bridge is more complex than its prototype Maxwell's bridge. The Anderson's bridge has more parts and is more complicated to set up and manipulate. The balance equations are not simple and in fact are much more tedious.

2. An additional junction point increases the difficulty of shielding the bridge.

Considering the above complications of the Anderson's bridge, in all the cases where a variable capacitor is permissible the simpler Maxwell's bridge is used instead of Anderson's bridge.

❖ PROCEDURE :

1. Connections are made as per the circuit diagram with an audio oscillator and head phones connected to proper terminals of the Anderson's bridge.
2. Connect the unknown inductor 'L' as shown in the circuit diagram.
3. Switch on the supply and select a certain value of 'C' say 0.01 F.
4. Adjust R1and r1alternately till the head phones give minimum or no sound.
5. Note down the values of S, M and C at this balanced condition.
6. Repeat steps (4) and (5) for the same inductance by selecting different value of C.
7. Repeat the above steps for different values of unknown inductance.
8. Switch off the supply.

❖ NOTE :

1. The value of 'C' is so chosen that there is sufficient adjustment available in the value of M.
2. When 'C' is small, 'M' will be large.
3. The bridge is useful for measuring small values of inductor such as 50, 100, 150 and 200 mH.

Note the value of unknown inductances

1. 10mH
2. 100mH

❖ OBSERVATION:-

S.NO	C(knowm capacitance)	r_1	R1	R2	R3	R4	L1

❖ CALCULATION :

'L' value is calculated by the given formula.

$$L_1 = C \frac{R_3}{R_4} [r1(R4+ R_2) + R_2R_4]$$

$$R_1 = \frac{R_2 R_3}{R_4} - r_1$$

❖ CONCLUSION:-